

Claims

1. A spectroscopic method comprising:
 energizing a solid state oscillator to generate a submillimeter wave and to sweep a predetermined frequency band;
 5 introducing the submillimeter wave during the sweep into a sample cell that contains a fluid;
 electrically generating frequency markers sequentially during the sweep;
 reading during the sweep outputs of a solid state detector disposed in the sample cell and detecting an absorption of the fluid;
 10 recording the read outputs of the solid state detector as a function of time and recording the frequency markers as a function of time; and
 converting the recorded outputs of the solid state detector into a function of frequency using the recorded frequency markers.
- 15 2. The spectroscopic method of claim 1, wherein the frequency markers are generated based on an output of the solid-state oscillator.
3. The spectroscopic method of claim 1, wherein the frequency markers are generated by mixing an output of the solid-state oscillator with an output of a crystal-
 20 reference oscillator.
4. The spectroscopic method of claim 1, wherein the frequency markers are generated by mixing and amplifying an output of the solid-state oscillator.
- 25 5. The spectroscopic method of claim 1, wherein the solid-state oscillator is a VCO of resonant frequency between 5 and 20 GHz.
6. The spectroscopic method of claim 1, further comprising amplifying or multiplying an output of the sold-state oscillator to generate the submillimeter wave.
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7. The spectroscopic method of claim 1, wherein the width of the frequency band swept by the solid-state oscillator is approximately 30 GHz.

8. The spectroscopic method of claim 1, wherein the center of the frequency band
5 swept by the solid-state oscillator is between 300 GHz and 400 GHz.

9. The spectroscopic method of claim 1, wherein the center of the frequency band swept by the solid-state oscillator is between 200 GHz and 500 GHz.

10 10. The spectroscopic method of claim 1, further comprising tuning the sweep of the frequency band into a frequency subband.

11. The spectroscopic method of claim 10, wherein the frequency subband has a width between 10 GHz and 100 KHz..

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12. The spectroscopic method of claim 10, further comprising positioning the frequency subband within the frequency band to avoid a background absorption.

13. The spectroscopic method of claim 1, further comprising selecting the outputs
20 of the solid-state detector that are correlated to the frequency markers in a time sequence of recoding, and utilizing only the selected outputs for the converting of the recorded outputs.

14. The spectroscopic method of claim 1, further comprising selecting the outputs
25 of the solid-state detector by an amplitude thereof, and using only the selected outputs for the converting of the recorded outputs.

15. The spectroscopic method of claim 1, wherein the reading of the outputs comprises integrating the outputs for a time period of 1 microsecond to 1 second.

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16. A method of measuring submillimeter absorption, comprising:

introducing a fluid containing a chemical species of interest into a trap;
cooling the trap so that the chemical species is in a condensed state;
reducing pressure of the trap to evacuate a remainder of the fluid that is not
condensed;

5 heating the trap to a first temperature so that the chemical species evaporates;
leading the evaporated chemical species into a sample cell; and
measuring absorption of the chemical species.

17. The method of measuring submillimeter absorption of claim 16, further
10 comprising keeping the pressure of the sample cell at approximately 10 mTorr during the
measuring of the chemical species.

18. The method of measuring submillimeter absorption of claim 16, further
comprises heating the trap to a second temperature that is higher than the first
15 temperature after measuring absorption of the chemical species, and repeating the steps
of heating to the sample cell and measuring the absorption.

19. The method of measuring submillimeter absorption of claim 18, wherein the
fluid contains another chemical species of interest, and the first and second temperatures
20 are determined by the boiling points of the chemical species.

20. A method of surveying an area for a chemical species, comprising:
taking air into a spectrometer at a first location;
receiving GPS coordinates at the first location;
25 measuring a submillimeter absorption spectrum of the air taken in at the first
location;
recording the absorption spectrum of the first location with the GPS coordinates
of the first location;
taking air into a spectrometer at a second location;
30 receiving GPS coordinates at the second location;

measuring a submillimeter absorption spectrum of the air taken in at the second location; and

recording the absorption spectrum of the second location with the GPS coordinates of the second location.

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21. The method of surveying of claim 20, further comprising sending the recorded spectra and the corresponding GPS coordinates to a receiving station over a wireless network.

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22. A spectrometer for measuring submillimeter absorption, comprising:
a solid-state exciter generating a submillimeter wave and sweeping a predetermined frequency band;

a frequency marker generating unit electrically generating frequency markers;
a sample cell to contain a fluid; and

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a solid-state detector detecting a submillimeter absorption of the fluid.

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23. The spectrometer of claim 22, further comprising a control system reading during the sweep outputs of the solid state detector, recording the read outputs of the solid state detector as a function of time, recording the frequency markers as a function of time, and converting the recorded outputs of the solid-state detector into a function of frequency using the recorded frequency markers.

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24. The spectrometer of claim 22, wherein the solid-state exciter comprises a solid-state oscillator.

25. The spectrometer of claim 22, wherein the solid-state exciter further comprises an amplifier and a multiplier.

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26. The spectrometer of claim 24, wherein the frequency marker generating unit comprises a crystal reference oscillator that is configured to mix with the solid-state oscillator.

27. The spectrometer of claim 22, wherein the frequency marker generating unit comprises a low pass filter and an amplifier.

5 28. The spectrometer of claim 24, wherein the solid-state oscillator comprises a VCO of resonant frequency between 5 and 20 GHz.

29. The spectrometer of claim 22, further comprising a sample trap connected to an upstream side of the sample cell.

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30. The spectrometer of claim 29, wherein the sample trap comprises a micro thermoelectric cooler.

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